National Aeronautics and Space Administration

# The Detection of Exozodiacal Emission around Vega with the Keck Interferometer Nuller


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## Project Objective

Implement a first of its kind nulling interferometer at the Keck Observatory.

Detect and characterize faint exozodiacal dust emission around nearby main-sequence stars

## Recent Results

The Keck Interferometer Nuller is fully operational

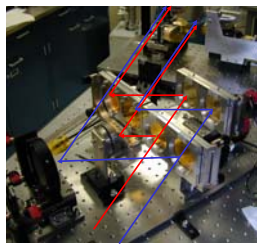
The shared-risk science phase has been completed:
Mid-infrared emission from the nova RS Oph has been detected
Exozodiacal emission has been detected around Vega, a nearby A star

One of the three recently announced KIN key science awards went to JPL

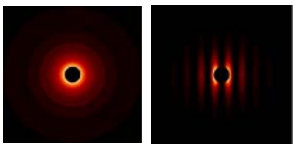
## Keck Interferometer Nuller (KIN) Project Description

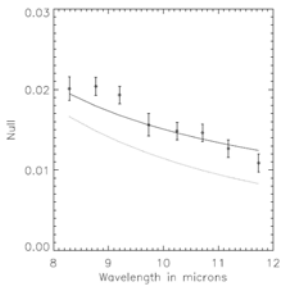
The main goal of the Keck Interferometer Nuller is to detect faint exozodiacal emission near bright nearby main-sequence stars. Such disks are analogous to our own solar system's zodiacal dust cloud, and might present an obstacle to future sensitive exo-planet imaging searches (with e.g. TPF-C or TPF-I) if the exozodiacal emission is too bright.

The KIN combines the starlight from the two Keck telescopes perfectly out of phase, so as to null the stellar signal, leaving the faint off-axis emission much easier to detect. The KIN operates in the 10 μm atmospheric window.



A symmetric KIN nulling beamcombiner






Top: Model for Vega's exozodiacal dust, and the flux transmitted by the KIN fringe response pattern. Right: Vega's measured null leakage. Bottom curve: predicted stellar leaage component. Top curve: a best fit to the leakage, with 500 zodis and a color temperature of 550 K.

In the shared-risk science phase, several detections were carried out:

- Emission in the RS Oph nova was detected. Dust seems to predate the explosion. Evidence for atomic emission lines.
- Warm exozodiacal emission was found on small angular scales around Vega, a young, nearby A star.
- Results on other nearby main-sequence and evolved stars are in process

KIN key science time awarded to JPL for an exozodiacal survey of nearby "dust-free" stars, as well as several dusty cases.

## Benefits to NASA and JPL (or significance of results)

Enables both nulling interferometry demonstration and exozodiacal science observations. Both scientifically and technically a prelude to TPF-I, or potential precursors to it. This is the world's first operational long-baseline nulling inteferometer, demonstrating a novel achromatic beam combination approach, as well as high-speed phase and dispersion control. The measurement of exozodiacal light around nearby stars with the KIN is the next step to understanding how prevalent and bright such disks are, and whether they are a serious hindrance to future exoplanet imaging with e.g., TPF-C or TPF-I.

## Publications


"The Keck Interferometer Nuller: System Architecture and Laboratory Performance," Serabyn, E. *et al.* 2004, ibid, p. 806.
"The Keck Interferometer Nuller (KIN): Configuration, Measurement Approach, and First Results," Serabyn, E. *et al.* 2005, in SPIE Vol. 5905, Techniques and Instrumentation for Detection of Exoplanets II, ed. D.R. Coulter, 5905OT-1.
"Science Observations with the Keck Interferometer Nuller," E. Serabyn et al. 2006, in SPIE Vol. 6268, p. 626815
"Nulling at the Keck Interferometer," M.M. Colavita, G. Serabyn, P.L. Wizinowich & R.L. Akeson 2006, ibid, p. 626803